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WASHINGTON, D. C. 20268-0001

POSTAL RATE AND FEE CHANGES, 1997	Docket No. R97-1

TESTIMONY OF

ANTOINETTE CROWDER

ON BEHALF OF

ADVERTISING MAIL MARKETING ASSOCIATION, DIRECT MARKETING ASSOCIATION, MAIL ORDER ASSOCIATION OF AMERICA, PARCEL SHIPPERS ASSOCIATION, AND ADVO, INC.

CONCERNING

CITY DELIVERY CARRIER LOAD TIME COSTS

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TESTIMONY OF ANTOINETTE CROWDER ON BEHALF OF THE JOINT PARTIES ON NOTICE OF INQUIRY NO. 3 CONCERNING CITY DELIVERY CARRIER COVERAGE-RELATED LOAD TIME

INTRODUCTION

My name is Antoinette Crowder and I am a senior consultant with TRANSCOMM, Inc, in Falls Church, Virginia. With respect to this Notice of Inquiry, I was asked to review the city carrier load time analyses and prepare comments on behalf of the parties listed above. The result of my review is described in this testimony. I have testified before the Postal Rate Commission on prior occasions and my autobiographical sketch is included as Attachment D to this testimony.

On January 12, the Commission issued Notice of Inquiry No. 3 (NOI) relating to USPS witness Baron's proposed treatment of city delivery carrier load time. The Commission requested comments on "the appropriateness of these and other possible changes to the established approach to measuring the variability of load time."

At the outset, it is important to note that the issues described in the Commission's NOI cannot be confined to coverage-related load time since, analytically, that time is interrelated with elemental load time and the correct estimation of total load time cost. Coverage-related load time, as the Commission recognizes in its NOI, is derived from a process that identifies and analyzes total city letter carrier load time within the USPS delivery system. In this testimony, this is called system-wide load time or, simply, load time.

The Commission has generally described USPS witness Baron's load time analysis as composed of three steps. However, two important analytical activities occur prior to those three steps and they are critical to a complete understanding of the correct approach to analyzing load time: (1) identification of the base year accrued load time, to which all of witness Baron's results are applied, and (2) development of the LTV stop load time models. In order to present a complete view of the load time attribution process, I include a discussion of these additional USPS activities.

The following section presents a brief summary and critique of the USPS approach, including the USPS development of base year accrued load time cost and the load time models. The next section describes the correct approach to determining load time volume-variability. The last section addresses the three questions posed by the Commission in the NOI. Three attachments present more detail on both my critique of the USPS approach and the correct, integrated, internally consistent approach to measuring load time variability.

I. SUMMARY AND CRITIQUE OF USPS LOAD TIME ANALYSIS

The USPS approach can be divided into four major activities: (1) identification of base year accrued load time costs, (2) development of base year load time models, (3) measurement of the volume-variability of load time from the LTV models, and (4) application of that volume-variability to the base year accrued load time costs. These activities are interrelated and must be fully integrated into a consistent analytical framework or the results are incorrect.

A. Identification of Accrued Load Time Cost

The initial step in load time attribution is identification of base year accrued load time, to which all of witness Baron's results are applied. From its accounts and from the IOCS proportion of city carrier in-office time, the USPS calculates out-of-office time by route type. The proportion of each route-type's out-of-office time which is considered accrued load time cost is based on the Street

Time Survey (STS) proportions by route type.[1] The route-type accrued load time costs are then summed to a system-level accrued load time which is allocated to stop-types on the basis of the Load Time Variability (LTV) modeled stop-type time proportions. Volume-variabilities developed in the subsequent variability analyses are then applied to these STS-based load costs.

B. Development of Stop Load Time Models

To appropriately evaluate load time volume-variability, witness Baron requires models of the stop load time function that reflect actual operations. He uses the Load Time Variability Test (LTV) data to model load time per stop for the purpose of deriving stop load time direct, or elemental, variabilities by mail shape and stop type. The LTV data include mail preparation, mail loading, customer attend times and volumes by shape at sampled stops.[2] Collecting actual data at

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1 These proportions are derived from the Street Time Survey the USPS conducted over a three-month period in 1986. This data collection sampled instants of letter carrier out-of-office time. The carrier essentially self-reported the activity he was performing at that sampled instant; there was no direct observation by a data collector. The sampled instant of time was signaled to the sampled carrier via a pager he carried with him on his route. He was signaled three times during the sampled day. For each of the three times the carrier was paged, he noted the activity he was performing at the time of the signal on a multiple-choice data card. At the start of the test day, the sampled carrier was prepared by a data technician and after the test, the sampled carrier was debriefed by a data technician. Approximately 2400 routes at 91 offices were sampled and about 7,100 tallies collected. (R87-1, USPS-7B) For purposes of this discussion, the key aspect of the STS results is that the carriers self-reported their activities without direct observation by a trained data collector. As discussed in Attachment A, they did not have the same guidance during the reporting process and apparently did not report in the same way that the trained industrial engineers reported in the LTV data collection.

2 Other necessary stop data were also acquired, including information on type of mail container, delivery receptacle, and number of possible deliveries at the stop. The LTV data were collected in the fall of 1985 by trained industrial engineers and were collected from a sample of about 400 city delivery routes.

(footnote continued on next page)

this level of detail is essential for the accurate modeling of load times per stop and the related elemental variabilities. Moreover, the LTV data were collected by industrial engineers under real operational circumstances while observing letter carriers delivering live mail to their stops. Thus, in addition to use for variability analysis, modeled load times developed through this "bottom up" approach are realistic when extrapolated to the system level.

Stop load time estimates and related elemental variabilities for the base year are developed by updating the LTV models with volume, stops, and deliveries data from the 1996 City Carrier Cost System (CCS). Average per stop volumes by shape and stop type are calculated and then used with the load time models to estimate average load times per stop by stop type in the base year.[3] Base year elemental load variabilities by stop type are then derived from these estimates.[4]

(footnote continued from previous page)
There were 16,011 SDR stops, 1,449 MDR stops, and 1,401 B&M stops sampled. (See, *e.g.*, USPS LR E- 4 and USPS-7C in Docket R87-1.)

3 The modeling is done by regressing LTV stop load time on LTV volume, possible deliveries and other stop data. Stop load time is the sum of LTV mail preparation, mail loading, and customer attend times. As specified by the Commission in R90-1, the explanatory variables include all statistically significant shape volume and cross-shape-volume variables as well as possible deliveries and all statistically significant cross-product variables derived from the interaction of shape-volumes and possible deliveries. Witness Baron does not change the models in any way. With one exception which will be described later, he simply updates them with base year data under the Commission-approved approach and applies a new interpretation to their results.

4 There are three stop-type load models derived from the CCS and LTV data: Single Delivery Residential (SDR), Multiple Delivery Residential (MDR), and Business and Mixed (B&M). Each is derived from stop-type-specific data. For ease of exposition, the rest of this testimony will discuss these LTV models as either one general model or as a set of models, without specifying the stop-type.

C. Inconsistency Between the LTV Modeled Load Time and the STS-Based Load Time

My analysis shows, however, that the STS-based accrued load time is inconsistent with the system-level load time estimate derived by multiplying the base year number of actual stops by the average stop time from the base year LTV models. The STS-based accrued load time exceeds by 47 percent the total system-wide load time estimated through the models. This substantial over-statement relative to LTV-modeled costs is not a new phenomenon but has existed since the STS proportions were first used in R87-1. Moreover, the STS proportions used to derive accrued costs are also substantially higher than proportions used prior to R87-1, based on CCS I and II data collected through observations of carriers delivering live mail. (These points are discussed in Attachment A.)

The inconsistency between the STS-based load time and the LTV-modeled load time causes a serious overstatement of elemental cost. Application of the elemental variability from the LTV load model to the STS-based load time yields elemental load cost which is inflated by 47 percent.[5] This inconsistency between LTV modeled elemental variability and the STS-based load time is only partially corrected by witness Baron's "fixed stop time" adjustment.

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5 The general expression for elemental variability is: (DT/DV)*(v/T). (v) is average stop volume obtained from the CCS data, DT/DV is derived from the LTV model updated with the CCS data, and T is the updated LTV modeled stop time. Thus, the system-wide average stop load time or cost (T), as measured by the LTV models, already appears in the denominator of the LTV elemental variability expression. And, elemental variability is dependent upon that LTV stop time. But, the LTV stop load time is considerably less than the system-wide average stop load time developed from the STS-based load time divided by the base-year number of stops. Separately, the same base year data are also used to develop the stops coverage variability. To be correct, the stop load time or cost must be consistent with the variabilities developed from the CCS and LTV models. This point is more fully described in Attachment A.

D. Load Time Variability Measurement

The three steps listed by the Commission describe witness Baron's interpretation of how volume affects load time. In Step 1, witness Baron measures what he calls the "stops effect." The Commission states that he defines this "as all time spent preparing to load mail." That is not entirely correct. Witness Baron clearly and correctly recognizes that mail preparation time, as reflected in the LTV data, is volume-variable. He states that mail preparation time:

> . . . is the handling of mail pieces, bundles, containers, or other mail-related equipment. As such, the mail preparation time interval is necessarily dependent on the volume of mail being loaded or collected. It will increase or decrease as volume increases or decreases. Thus, as defined, mail preparation time does not include the pre-loading prep time encompassed by fixed-time at a stop, since the latter, by definition, is completely independent of total volume loaded or collected at a stop. [Response to NAA/USPS-T17-4(a)]

Further, the LTV models he uses are estimated using total LTV stop load time, including mail preparation time.[6] Thus, the elemental variabilities he derives from the models in Step 2 include the variability of mail preparation time at the stop with respect to stop volumes.

As noted by the Commission, however, witness Baron estimates an average "fixed stop time" per stop from the LTV data base. Multiplying this estimated "fixed stop time" by the base year number of actual stops generates witness Baron's total "fixed stop time." He considers this time to be volume-variable to the same extent as accesses or stops and, therefore, adds it to access time. Base year (system or route-level) stops-coverage variability derived from the

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[6] The LTV stop time data were collected as separate mail preparation, mail loading, and customer attend times. (The industrial engineers collecting the data were given specific instructions as to precisely what these meant.) Despite his fixed stop time analysis, witness Baron does not eliminate any LTV time when developing the models, although he clearly can identify preparation time.

CCS stops-coverage model is then applied to this combined cost pool to determine total volume variable access and "fixed stop" time.[7] This step was performed separately for each of the stop types.

After identifying the "fixed stop time" and adding it to access time, witness Baron then reduces the STS-derived accrued load time by the corresponding amount. As discussed more fully in Attachment A, witness Baron's fixed stop adjustment partially corrects the inconsistency between the LTV model variability and the STS-based accrued load time.

With respect to the remaining, non-fixed-stop-related load time, however, witness Baron incorrectly interprets it as strictly unrelated to system- or route-level stops coverage. According to witness Baron, this load time is variable as a result of both the "volume effect" and the "deliveries effect" on load time at a stop. He uses the LTV models to determine these variabilities, as described in steps 2 and 3 below.

In step 2 of his model evaluation, he measures the volume effect. This is simply the modeled stop load time variability (*i.e.,* LTV variability or elemental variability). To measure the elemental volume effect, he effectively calculates marginal and average per piece stop load time by piece shape from the LTV model. These are then used to develop the corresponding elemental load

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[7] The base year CCS data are used to measure (a) the variability of stops coverage with volume and (b) the variability of deliveries coverage with volume. Coverage in both cases is intended to represent route-level or system-level coverage. These variabilities are derived in USPS LR H-138 and are developed in the same way as the Commission specified in R90-1. In the present discussion, the variabilities are called stops-coverage variability and deliveries-coverage variability.

variabilities.[8] To calculate elemental load time, he applies the elemental variabilities to the STS-based load time, reduced by the amount of his "fixed stop time." Because it was developed with the adjusted STS-based load cost, witness Baron's elemental load cost is overstated. His "fixed stop time" adjustment only partially corrects the STS-based cost overstatement.

In Step 3, witness Baron separately estimates from the LTV model a "deliveries" variability for MDR and B&M stops to account for a "deliveries effect." He claims this "deliveries" variability measures changes in load time per stop as actual deliveries per stop vary with volume. Thus, for multiple delivery stops, he estimates two stop load time variabilities: elemental variability (Step 2) and deliveries variability (Step 3). According to witness Baron, elemental variability is the direct volume effect, arising from volume by shape. And, according to him, the deliveries variability is a separate indirect volume effect caused by the number of actual deliveries at a stop, arising from the coverage-generating characteristics of individual subclasses. Since SDR stops have only one delivery, there is no deliveries effect associated with them.

As discussed in Attachments B and C and outlined briefly in the next section, witness Baron is incorrect in his interpretation of the stops- and deliveries effects on load time. All non-elemental load time should be considered variable to the same extent as stops coverage. And, separately attempting to estimate a deliveries variability for MDR and B&M stops is unnecessary. The elemental

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8 For SDR stops, witness Baron correctly develops the elemental variability just as it has always been calculated since R90-1. However, for multiple delivery stops (MDR and B&M), he mis-estimates elemental variability when he incorrectly updates the models with base year actual stop data rather than the possible stop data consistent with the LTV model coefficients. As discussed in Attachment C, this error is a result of his unnecessary effort to identify the "deliveries effect."

variability measured from the stop load model already includes the effect of a marginal volume change on stop load time caused by both (1) the actual loading of mail at existing deliveries (the direct elemental effect) and (2) the number of new deliveries loaded (the indirect coverage effect). Attempting to estimate and include one of these variabilities a second time (in a different way) causes an over-estimate of load time variability, even when that variability is applied to the correct amount of accrued load cost.

II. THE CORRECT APPROACH

The Commission's puzzlement with respect to the USPS treatment of the stops and delivery effects is not surprising. Although it has improved the load time analysis with its fixed stop time adjustment, the USPS approach has not been developed within an integrated, internally consistent analytical framework. However, an integrated, internally consistent approach can be developed from the LTV and CCS data which is conceptually similar to the traditional approach taken by the USPS and the Commission in previous cases. This approach can be used to address the three questions posed by the Commission in its Notice of Inquiry.

A. System-Wide Load Time

At the simplest level, total system-wide load time is load time per stop multiplied by number of actual stops. Accordingly, volume affects *system-wide* load time through:

- Time per actual stop, which is directly affected by volume on the stop, and
- Number of actual stops, which is affected by volume in the system, through the *system or route level* stops-coverage phenomenon.

Once system-wide base year load time is correctly estimated, system-wide volume-variable load time can then be estimated. Mathematically, and as demonstrated in Attachment B, volume-variable system-wide load time is the sum of:

- Elemental load time (*i.e.*, the product of system-wide load time and the LTV model elemental variability), and
- System-wide non-elemental load time (*i.e.*, coverage-related load time) multiplied by the *system or route level* stops-coverage variability.

B. Elemental Load Time

The first component of system-wide load time is elemental load on a stop, which can be derived from the base year LTV models and, for multiple delivery stops, already includes witness Baron's "deliveries effect." It can be easily demonstrated that elemental load time already includes the indirect effect of *volume on stop load time caused by changes in the number of actual deliveries* per stop. Thus, the deliveries effect is already part of the Commission's previously accepted elemental load time concept. No further analysis or adjustment is required.

Simply stated, volume impacts *stop* load time through:

- *Time per actual delivery, which is directly affected by volume on* the delivery, and
- Number of actual deliveries, which is affected by volume on the stop, through the *stop-level* deliveries-coverage phenomenon.

Thus, elemental load time at the stop level includes both the direct elemental effect as well as the deliveries-related effect. This is described more fully in Attachments B and C.

C. Coverage-Related Load Time

The second component of system-wide load time is coverage-related load time. This time can be interpreted as the non-elemental load time which includes the fixed time incurred as a result of the need to make a load, *e.g.*, fixed time to open and close the satchel and mail box. Like access time, it is variable to the same extent as stops coverage is considered variable. This is correct for all three stop types. Thus, for MDR and B&M stops, the correct approach described here differs from the traditional approach followed by the USPS and the Commission in previous cases. Under the traditional approach, the non-elemental load time from MDR and B&M stops is treated as variable to the same extent as *deliveries* coverage. As discussed above and in Attachment B, the deliveries effect on stop load time is already included within elemental variability.[9]

D. Integration of LTV and STS Times

Finally, both the elemental and stops-coverage variabilities should be applied to a system-wide load time cost that is consistent with the data used for variability measurement. System-wide load time and variabilities can change as volumes, stops, and deliveries change. Thus, applying elemental variabilities from the LTV models to STS-based load times yields biased results unless the system-wide load time estimates from both sources match. Another way of stating the consistency requirement is that system-wide load time estimates, to which the variabilities are applied to derive elemental load time, should be the values that are also used to estimate elemental variabilities. To ensure accuracy and consistency, the LTV models, updated with base year CCS data, must be used to develop system-wide load time estimates to which the elemental load variabilities are applied.

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9 The correct measure of the deliveries effect on stop load time is the variability of the non-elemental delivery time on a stop. In any case, the deliveries-coverage variability developed by the USPS (and applied by witness Baron to load time within a stop) is a system- or route-level deliveries-coverage variability, not a stop-level deliveries-coverage variability. Even if a stop-level deliveries-coverage variability were required, the USPS value is clearly the wrong variability.

Separately, as discussed in Attachment A, there is evidence that the STS-based load time is derived from a broader definition of load time than is the LTV modeled time. The difference between the LTV and STS load times appears to be relatively fixed stop time included in the STS data but excluded from the LTV data. Accordingly, the cost difference between the two data sources should be treated as USPS witness Baron has already proposed: as fixed stop load time, variable to the same extent as stops-coverage. This produces an integrated, internally consistent approach.

E. Summary of Correct Approach

In summary, the following is the correct approach to evaluating system-wide load time:

(1) The LTV models are specified with base year CCS volume and deliveries data. These models provide the average time per stop for the given base year conditions. When the average time per stop is multiplied by the base year number of actual stops from CCS, the result is total system-wide load time.

(2) The LTV models specified with base year CCS volume and deliveries data are also used to develop elemental or direct volume-variability. This variability represents the proportion of stop load time which varies directly (100%) with volume. It is multiplied by system-wide stop load time to generate elemental load time.

(3) The residual (non-elemental) system-wide load time is then multiplied by the stops-coverage variability. This variability is estimated from the stops-coverage model developed from base year CCS volumes and stops.

This integrated, internally consistent approach resolves two problems witness Baron appears to be addressing:

(1) Accrued system-wide stop load time is directly related to the modeled load time, so that there is no need to make *ad hoc* adjustments in the STS-derived accrued load time estimate, such as witness Baron's fixed time per stop, and

(2) Variability associated with number of actual deliveries on the stop, as witness Baron attempts to estimate, does not need to be estimated at all. The volume-related deliveries-coverage effect on the stop as well as all direct volume effects on stop load time are already reflected in the stop load time variability (elemental variability).

Tables 1, 2, and 3 compare witness Baron's approach to the correct approach. In those tables, the cost difference between the LTV-modeled load cost and the STS-based load cost is treated as fixed stop time. The rationale for this treatment is discussed in Attachment A.

III. THE COMMISSION'S THREE QUESTIONS

Given the correct and consistent approach outlined above, the Commission's three questions are easily answered. Thus, some of the following is repetitive in order to directly and completely respond to the three questions posed by the Commission.

(1) Does delivery coverage affect SDR stops as a group in the same general way that it affects MDR and BAM stops as a group?

As the Commission recognizes, coverage of deliveries within a stop is a phenomenon similar to coverage of stops within a system of stops (at the route level). Just as system-wide load time is the product of average stop time and number of stops within the system, average stop load time is the product of average delivery time and number of deliveries within the stop.

As discussed above, there is, however, an implementation difference. The LTV models are models of stop load time (not system delivery time and not system load time). For all three stop types, the elemental variabilities derived from the LTV models are stop-level variabilities. As part of the modeling process, the volume coefficients in the LTV models reflect all load time changes caused by volume, both the direct (elemental) changes as well as the indirect (deliveries-coverage) changes. Elemental stop variabilities on multiple delivery stops include both the direct volume effect on *delivery* load time (elemental deliveries effect) and the indirect volume-related *deliveries*-coverage effect. Stated differently, the elemental stop load times estimated from the models for MDR and B&M already reflect both the direct (elemental) and the indirect (deliveries) volume effect on stop load time.

With respect to the Commission's hypotheticals, it is important to emphasize that the LTV elemental variability includes all variability associated with mail preparation time at the stop, as well as with mail load time and customer attend time. As the Commission recognizes in its NOI, mail preparation and load time are generally bulk or bundle handling activities (at least for SDR and most B&M stops) and there may be interactions between different shape volumes or between volumes and different stop characteristics, such as number of possible deliveries. Further, there is typically some fixed time at each stop for activities such as adjusting the satchel, opening and closing the mail receptacle, checking for mail not picked up by addressee or for collectibles (for MDR and B&M), turning around to retrace the access, etc.

Since the LTV data are operational data from city carriers on their routes, these real-life effects on stop load time are all captured in the LTV data, models, and variabilities.[10] Thus, both individual volume- and cross-volume-variabilities

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10 Because there was considerable saturation volume in 1985 and the Load Time Variability Test Industrial Engineer Package specifically recognized the need to account for saturation volume during the test, saturation flats and letters were undoubtedly included in the data. (See, *e.g.,* USPS LR E-4, pages 7, 13, 15, 22, 38, 39). And, the cross-volume effects in the models recognize any interactions between different shape volumes – such as some of those posited by the Commission's hypotheticals. (The LTV time data includes the times associated with such things as "combining flats and circulars from separate bundles," see, *e.g.,* USPS LR E-4, pages 39, 40, and 41.) Obviously, however, there were no non-saturation delivery point sequenced letters at that time. There is no reasonable way to correct this situation. For future analyses and after DPS is fully

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are correctly and reliably derived from the models. And, quite correctly, those models show that there is some portion of total stop load time which is not volume-variable at the stop level – that is, not all stop load time is elemental load time. However, that non-elemental portion of total stop load time is indirectly variable with volume to the same extent as stops coverage is variable with volume.

If one attempts to derive useful variability information from the Commission's hypotheticals, it becomes clear that, without carefully developed models of stop load time, it is impossible to quantify the separate load time-causing effects from piece volume by shape, bundle types, possible and actual stops, possible and actual deliveries, and the various stop and delivery characteristics such as container types, customer requirements, etc.

Thus, what matters in the variability analysis is the extent of change in actual stop load time as volume changes, leaving all other causal elements constant. Capturing that effect through a stop load time model developed from real operational data allows the marginal volume effect on load time to be isolated and correctly estimated. This was the reason for collecting system-wide LTV data, performing econometric analyses with that data, and developing representative load time models. The variabilities derived from the LTV stop load models reflect all volume effects occurring within the stop, whether they are due to shape volumes, inter-actions between shape volumes, other stop characteristics, bundle handlings, or actual deliveries on the stop.

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implemented, new LTV data from delivery carriers with experience in DPS mail should be collected. These data can then be used to develop the representative stop type models.

(2) For SDR stops, should the stop coverage model advocated by witness Baron be used to regress total accrued load time (not adjusted for any "stops effect") simultaneously on delivered volume and on actual stops (the equivalent of actual deliveries), in the same general way that witness Baron applies his delivery coverage models to MDR and BAM stops?

Although I am unsure how one could regress total accrued load time on delivered volume and stops, the Commission appears to be suggesting a regression of total SDR load time on total SDR volume and actual stops (comparable to witness Baron's regression of MDR stop load time on possible deliveries per stop). The Commission's question also appears to be probing for a way to estimate system-wide load time variability which would reflect the combined volume effects on elemental load time, stops coverage, and deliveries coverage.

The correct approach is the one I have outlined above. It shows how to calculate total system-wide volume-variable load time for all three stop types. And, conceptually, the analysis of system-level load time with respect to the system-level (route-level) stop-coverage effect is exactly the same as the analysis of stop-level load time with respect to the stop-level delivery-coverage effect. Only implementation is different. Thus, under the correct approach outlined above, the volume-variable load costs appropriately reflect the direct volume effect as well as the indirect volume effect caused by stops and deliveries coverage characteristics. In all cases, the LTV models should be estimated using LTV stop load time, stop volume, and other stop-specific characteristics. This gives the Commission the information it is looking for: system-wide variability of load time.

(3) If the effect of actual deliveries on load time is accounted for econometrically for all stop types, is there any load time remaining that can be associated with actual stops?

The Commission appears to be correctly anticipating that the "deliveries effect" (deliveries-coverage variability) is already included in the elemental load variabilities for MDR and B&M. That is, as discussed above, it is already accounted for econometrically in the LTV model variabilities. The remaining (non-elemental) load time should be considered volume-variable to the same extent as *stop* coverage is volume-variable. In other words, non-elemental stop load time should be multiplied by the volume-related stops-coverage variability to produce volume-variable coverage-related load time. As discussed above, none of non-elemental stop load time is related to deliveries coverage.

TABLE 1

1996 SDR LOAD TIME COSTS (000s)

	USPS-T-17 (STS Cost)	LTV Modeled Cost	LTV/STS Cost Difference
ACCRUED	$995,848	$702,622	
FIXEDSTOPTIME	139,405		$293,226
VOLUME VARIABLEFIXED STOPTIME	11,608		24,418
ELEMENTAL	522,577	428,719	
DELIVERY-RELATED			
STOPS-COVERAGE-RELATED		273,903	
VOLUME VARIABLE COVERAGE-RELATED		22,809	
TOTALVOLUME VARIABLE COST	$534,185	$451,528	$24,418

Notes on columns (2) and (3)

(1) LTV modeled load time cost is derived in Attachment A

(2) Treatment of LTV modeled load time and LTV/STS cost difference is described in Attachment A

(3) LTV Volume-Variability = .61017 (USPS LR H-137)

(4) Stop Coverage Volume-Variability = .083273 (USPS LR H-138)

TABLE 2

1996 MDR LOAD TIME COSTS

	USPS-T-17 (STS Cost)	**LTV Modeled Cost**	**LTV/STS Cost Difference**
ACCRUED	$600,905	$351,733	
FIXED STOP TIME	13,226		$249,172
VOLUME VARIABLE FIXED STOP TIME	1		
ELEMENTAL	417,405	229,080	172
DELIVERY-RELATED	45,087		
STOPS-COVERAGE-RELATED		122,653	
VOLUME VARIABLE COVERAGE-RELATED		8	
TOTAL VOLUME VARIABLE COST	$462,493	$229,088	$172

Notes on columns (2) and (3)

(1) LTV modeled load time cost is derived in Attachment A

(2) Treatment of LTV modeled load time and LTV/STS cost difference is described in Attachment A

(3) LTV Volume-Variability = .65129 (USPS LR H-137)

(4) Stop Coverage Volume-Variability = .00069 (USPS LR H-138)

TABLE 3

1996 B&M LOAD TIME COSTS

	USPS-T-17	LTV Modeled Cost	LTV/STS Cost Difference
ACCRUED	$186,333	$159,278	
FIXED STOP TIME	10,722		$27,055
VOLUME VARIABLE FIXED STOP TIME	337		850
ELEMENTAL	92,486	82,995	
DELIVERY-RELATED	2,060		
STOPS-COVERAGE-RELATED		76,283	
VOLUME VARIABLE COVERAGE-RELATED		2,396	
TOTAL VOLUME VARIABLE COST	$94,883	$85,391	$850

Notes on columns (2) and (3)

(1) LTV modeled load time cost is derived in Attachment A

(2) *Treatment of* LTV *modeled load time and* LTV/STS *cost difference is described* in Attachment A

(3) LTV Volume-Variability = .52107 (USPS LR H-137)

(4) Stop Coverage Volume-Variability = .031408 (USPS LR H-138)

ATTACHMENT A

DISPARITY BETWEEN THE LTV MODELED TIME AND THE STS LOAD TIME

This attachment describes the disparity between the LTV modeled load time and the STS-based load time, identifies possible reasons for the disparity, explains why application of the LTV elemental variability to the STS-based load time seriously overstates elemental load time, and offers a correction to the problem.

The Disparity

System-wide LTV modeled load time is calculated by multiplying the average LTV modeled stop load time by the CCS number of actual stops in the system. Comparing this LTV modeled system load time to the STS-based load time figure shows that the STS-based load time (both system-wide and on a per stop basis) is almost 47% greater than the LTV derived value ($1,783,086/$1,213,633).

Stop Type	**1996 STS-Based System Load Cost (USPS-T-17)**	**1996 LTV Modeled System Load Cost**
Single Delivery Residential	$995,848,000	$702,622,000
Multiple Delivery Residential	$600,905,000	$351,733,000
Business & Mixed	$186,333,000	$159,278,000
Total Load Cost	$1,783,086,000	$1,213,633,000

Note: Modeled load cost is developed at the end of this attachment.

Although elemental load time variability is derived from the LTV model, it is applied to the much greater STS-based total load time cost. Because the STS value exceeds the LTV value by almost 47%, the elemental load time is also overstated by the same percentage. Thus, the inconsistency between the LTV and STS load times causes a serious problem in calculating the elemental load cost.

The reason for the inconsistency between LTV and STS appears to arise from the definitions of stop load time which differ between LTV and STS data collections. It appears that the LTV load time definition principally encompasses the time the carrier actually handles mail, mail equipment, or customer requirements while the STS definition is broader, possibly to the extent that it may even extend to a portion of access time. Thus, the excess of STS time over LTV modeled time is likely fixed stop-related. The LTV data collection was specifically designed for the purpose of developing stop load models which could be used to estimate elemental variability. And, it was performed by industrial engineers who understood its design and directly observed carrier load activities under operational conditions and were trained to measure precise definitions of mail preparation, load, and customer attend times at the stop, as opposed to all other operational time which was defined by LTV as "interstop" time.

In contrast, the STS data collection, although also taken during operational conditions, was self-reported by the sampled carriers. Those carriers were signaled through radio beepers at specific instants of time during their sampled day. For those instants of time, they were to report their activity. They appeared to have very general guidance as to their reporting requirements and they were given a list of activities, one of which they were to choose for each sampled instant of time. The activities on the list were broad categories which could encompass a number of specific activities. For example, loading mail at a delivery was not specified; rather, the following broad STS categories reported by the carriers were considered load time: "to, from, or at delivery not routine," "at delivery stop - curbline," and "at delivery stop - not curbline." (R87-1, USPS-7B)

Thus, it appears that both the STS and LTV load times reflect carrier time incurred at stops and deliveries. However, the LTV load time, because it is more narrowly defined to include principally volume-related time, is considerably less than the STS load time, which likely includes both the volume-related (LTV-defined) stop time plus relatively fixed (non-volume-related) stop time, and perhaps even a portion of access time.

The Inconsistency Problem

The problematic inconsistency between the LTV-derived elemental variability and the STS-based accrued load cost is described as follows. The elemental variability expression is:

$$(dT/dv) / (T/v),$$

where (dT/dv) is the marginal stop load time and T/v is the average per piece stop load time, both of which are estimated from the LTV model. Average stop volume is (v) or (V/S) which is derived from the CCS base-year system-wide data on volume (V) and actual stops (S) by stop type. Elemental variability is calculated from the model's average and marginal load times.

System-wide elemental load time (ELT) can then be developed in one of two ways:

$$ELT = (dT/dv) * V, \text{ or}$$

$$ELT = [(dT/dv) / (T/v)] * (T * S),$$

where (T * S) is the LTV and CCS derived system-wide load time.

However, if, in the second expression, (T * S) is replaced with (L), which is the STS-based load time, and (L) is 47% greater than (T * S), then:

$$\begin{aligned} ELT &= [(dT/dv) / (T/v)] * L \\ &= 1.47 * [(dT/dv) / (T/v)] * T * S \\ &= 1.47 * (dT/dv) * V . \end{aligned}$$

This shows that elemental load time developed by applying the LTV variability to the 47%-greater STS load cost inflates system-wide elemental load time by 47%.

A Correction of the Inconsistency

It appears that (1) both the STS and modeled LTV load times are system-wide stop-related times and (2) the difference between them is due to differing definitions of the times used to collect the data. Accordingly, the LTV definition of load time can be considered a narrower definition which encompasses only the carrier's direct handling of mail, mail-related equipment, and customer requirements at the load point while the STS definition of load time not only includes the LTV-defined activities but also more general stop-related activities.

Given that interpretation, the difference between the modeled load and the STS-based times is likely due to fixed stop time which was consistently excluded from the LTV data but included in the STS data. Thus, an adjustment is required to the LTV-derived elemental variability in order to estimate the correct elemental cost. The required adjustment is:

$$E_L / 1.47 = E_S,$$

where, E_L is the LTV elemental variability, and
E_S is the elemental variability applied to the STS-based load cost.

To obtain the elemental variability applicable to the STS load time, the LTV modeled variability is divided by 1.47. Applying the adjusted LTV elemental variability to the STS-based costs provides the correct elemental load time. (In effect, USPS witness Baron's fixed stop time adjustment is equivalent to this proposed adjustment, with the exception that his implicit divisor is substantially less than 1.47.) Finally, the non-elemental portion of the STS-based accrued load time is then treated as coverage-related load time and considered variable to the same extent as stops-coverage.

The revised load time costs in Tables 1, 2, and 3 of this testimony are developed in accordance with the above analysis. The LTV model elemental variabilities are applied only to the LTV-modeled system-wide load costs while the non-elemental, system-wide stop-related time is treated as variable to the same extent as stop coverage.

Factors Explaining the Disparity

(1) The LTV data were carefully collected by trained industrial engineers, with special timing devices (OS-3 Event Recorders), under actual operational conditions, following carriers' activities over a portion of their routes. The data were collected with the specific intent of developing stop load time models for purposes of evaluating load time variability. The industrial engineers were given specific instructions as to the carrier activities to include within the preparation, load, and customer attend times which are included in the modeled load time (USPS LR E-4). It is likely that most of the fixed time at the stop prior to carrier movement toward mail preparation and after carrier mail-related activities were completed was excluded. Because of the manner in which the data were collected, the direct observation of actual operational conditions, and the large number of observations of stop load time, the LTV data and, therefore, LTV-modeled load time are reliable estimates of stop load time, as defined by the LTV data collection instructions.

Since the LTV data and models were first introduced, they have been given considerable attention. In R90-1, the Commission finally settled on an accepted modeling approach which has not since been challenged. Separately, the annual CCS data collection, which provides the base-year volumes and actual stops for city carrier letter routes, was introduced in R84-1. To my knowledge, the reliability of the CCS data has never been challenged.

(2) The LTV load time models are updated with base year volume and actual stop data from the base year CCS. Over the time the models have been in use, base-year average stop volume by shape has changed only slightly and, so, modeled load time and variability have also changed only slightly. Average modeled stop load

time has only increased 4% since base year 1987, although modeled system-wide load time has increased almost 11% (due to a greater than 5% increase in actual stops).

(3) The Street Time Survey (STS) data were collected in 1986 and presented in R87-1. The data collection was designed to sample instants of carrier time while on the route, but without direct observation by data collectors. The intent of the survey was to acquire data useful in allocating city letter carrier out-of-office time by operational components (*e.g.*, load time, CAT and FAT run time, travel time, collections time). But, contrary to earlier, exceptionally thorough data collections supporting allocations of out-of-office time [*i.e.*, CCS I and II, described in (5) below], STS was designed to minimize (1) effort on the part of the data technician and (2) intrusion into the carrier's activities. Thus, a sampled carrier self-reported his activity at the time of each tally (signaled to him through a radio pager) on a small "reminder card" that he carried with him throughout the sampled day. At the end of the sampled day, the carrier was debriefed by a trained IOCS/STS data technician.

Because the carrier had to self-report, the specificity of the data collected was necessarily limited to relatively broad operational categories from which he could easily choose on the small "reminder card" that he carried with him. For example, these included activities such as "carrier stopped at delivery stop," "carrier walking from collection box," "carrier driving to curbline delivery stop." In fact, preparing or loading mail at a (curbline or non-curbline) delivery stop was not even one of the activities available for him to check off. The bulk of the STS load time proportion comes from the "reminder card" categories called "to, from, or at delivery not routine", "at delivery stop - curbline", and "at delivery stop - not curbline." (R87-1, USPS-7B).

Given the diversity of activities that a letter carrier actually undertakes on his route, it is likely that a carrier's interpretation of how to record his sampled instant of time might not match the intent of the activity choices on the STS "reminder card" or correspond to the LTV-type definitions of load time activities. This seems especially the case when he may consider himself "stopped" at a delivery stop but has not really begun preparing or loading mail. Even if he were especially conscientious about his reporting, it seems unlikely that he could identify, for example, "stopped at delivery stop" (tallies for which were included within the STS load function) in precisely the same way as an industrial engineer taking LTV data (and understanding how that data would be used) would identify mail preparation and load activities. Thus, it is not surprising that the STS accrued load time and the LTV modeled load time do not match. The mismatch is, however, a bit more than expected.[1]

The STS results were challenged in R87-1 but, with some minor revisions, the Commission accepted the results. The Commission and the USPS have used the R87-1 revised STS out-of-office proportions ever since.

(4) Since they were first implemented, the STS load proportions have generated a load time cost over 40% greater than the comparable modeled LTV time cost (46.1% in 1987 and 46.9% in 1996). Thus, the disparity is not a new phenomenon but has remained relatively constant. Given that the LTV-modeled *stop* time and the relationship between LTV-modeled and STS-based *system-wide* times have both remained relatively constant, there appears to be a link between them.

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[1] Some of the known adjustments in the STS load time proportions definitely do not match the LTV data as defined by preparation, load and customer attend times. For example, the STS load time proportions also include the STS proportions for collection activities at collection boxes, delivery retrace activities, and customer contacts (some of which may not be the same as the LTV customer attend). An initial review of these activities, however, shows them to be a relatively small proportion of total carrier time. Additionally, the STS load time proportions may also include "accesses" among delivery points within multiple delivery stops, which would have been excluded in the LTV data. Further, the STS load time proportions likely also include bulk delivery activities which the LTV data and model are not designed to assess. (The latter activities, because they are in bulk, are obviously not volume-variable, either elementally or with respect to stops coverage and, therefore, do not need analysis. To the extent costs associated with bulk deliveries are in the STS data, even with the proposed correction described above, they may cause an overstatement of variable coverage-related load cost.)

Both times vary with the number of actual stops, with the interpretation that the LTV time is the portion which may vary with volume (although stop volume has not varied substantially over time) while the difference between LTV-modeled and STS times represents fixed stop-related time.[2]

(5) The STS time proportions were first applied in 1987. In that year, the STS results indicated that load time was 26.8% of out-of-office costs. In contrast, over the previous four years (1983-1986), load time, based on the CCS I and II data, was 16.0% to 16.1% of out-of-office costs. With the use of STS, the CRA load time proportion increased almost 68% from 1986 to1987. This is a particularly interesting comparison because CCS I and II data were collected by trained teams of industrial engineers and data technicians. Like the LTV industrial engineers, the CCS I and II engineers and technicians actually observed the sampled letter carriers as they performed on their routes. They also used special timing devices and precise activity definitions to ensure accuracy and consistency in the collected time data.[3] No

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2 The ratio of STS access time to modeled FAT/CAT access time has also remained relatively constant (*i.e.*, STS was approximately 25.6% greater than FAT/CAT in 1987 and 23.8% greater in 1997). The remarkable consistency over time between modeled LTV and FAT/CAT times and the STS proportions indicates that the vast majority of letter carrier out-of-office time is related to the number of actual stops. (It was never expected that the FAT/CAT modeled access time would match the STS-based accrued time. In part, this is because the FAT/CAT models are not designed to specifically identify actual run or access time. They instead were designed to identify the base-year ratio of route to access time resulting from changes in actual stops on routes. For that purpose, they generate useful variabilities which can be applied to the STS-based accrued run time.)

3 The CCS I data were collected in 1979 for the six types of residential and mixed routes. The CCS II data were collected in 1980 for the two types of business routes. The CCS I data were implemented in the R80-1 case while the CCS I and II data were used in the R84-1 case. Of particular interest is the description of the approach and the preparations for the data collections, including the training of the engineers and technicians. (R80-1, USPS-T-7; and, R84-1, USPS-T-8).

challenges to the CCS I and II data were discussed in the Commission's Opinions for R80-1 and R84-1.

The disparity between the STS and the CCS I and II load time proportions also reinforces the notion that industrial engineers (performing both the LTV and CCS I and II collections) were more stringent in their definition of load time than were delivery carriers (self-reporting the operations for their STS tallies).

1996 LTV/CCS MODELED SYSTEM LOAD TIME

Stop Time	Actual Stops (000)	LTV Model Sec./Stop	Total Load Time (Sec.) (000)	Total Load Time Cost (000)
SDR	12,331,265	8.29	102,199,574	$ 702,622
MDR	1,012,826	50.51	51,161,135	351,733
B&M	1,188,114	19.50	23,167,749	159,278
Total	14,532,205	12.15	176,528,458	$ 1,213,633

Sources: Actual Stops from USPS-T-5 (WS B 7.0.4.1, lines 23-26)
Load time from the Commission models in USPS LR-H-137
Average hourly city carrier rate of $24.75 (USPS LR-H-212)

ATTACHMENT B

DERIVATION OF SYSTEM-WIDE LOAD VARIABILITY

This attachment explains both conceptually and mathematically the proper approach to deriving system-wide load variability for both single delivery stops (SDR) and multiple delivery stops (MDR and B&M). It shows that the correct load time variability measurement for all stop types requires using the stop coverage variabilities derived from the CCS stops-coverage models along with the stop-level elemental variabilities derived from the LTV models.

Measurement of system-wide city carrier load time variability requires estimation of load time changes caused by volume variations within a system of routes. Under the current method of analysis, load time changes in response to volume changes are measured for stops comprising a representative portion of an average route.[1] This attachment describes the conceptual model supporting the Commission-approved approach to estimating load time variability as the sum of (1) elemental load variability (for elemental load time) plus (2) stops-coverage variability multiplied by one minus the elemental load variability (for coverage-related load time).

There are two parts to this description. The first part describes measurement of system-wide load time variability for single delivery stops. The second part then extends the description to multiple delivery stops.[2] Conceptually, the two parts are integrated and consistent with the USPS LTV stop load time models.

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1 The USPS develops a representative portion of an average route for each stop type since stop coverage and volumes vary by stop type. For purposes of exposition, this description uses the term system-wide when the actual analysis is at the system average route-by-stop-type level.

2 This attachment supports the Commission-approved variability approach, with one exception. Coverage-related load time should be considered volume-variable to the same extent as stops-coverage is variable, for all three stops types. Currently, the Commission-approved method is that coverage-related load on single delivery stops

(footnote continued on following page)

A. Variability of System-Wide Load Time For Single Delivery Stops

System-wide load time is simply the product of average stop load time and the number of actual stops in the system. As total delivered volume in the system varies, system-wide load time varies with changes in either (1) average stop load time and/or (2) number of actual stops. System load times and related variabilities can be calculated using the stop-level data from the LTV and CCS databases. The LTV stop load models permit measurement of changes in load time per stop as volume per stop varies; and the CCS stops-coverage models allow measurement of changes in actual stops as system-level volume varies.

System-wide load time variations caused by the volume effects on average stop load time and number of actual stops are interrelated. For example, for a given increase in system volume, when more of the increase goes to new stops, less goes to existing stops and vice versa. Thus, when more of the increase goes to new stops rather than existing stops, system-wide load time increases more as a result of the new stops rather than as a result of an increase in average stop load time.

Analytically, the system-wide load time variability analysis captures both the effect of volume going to a new stop as well as the effect of volume going to an existing stop. The change in average load time (for existing stops) caused by a marginal change in average stop volume is the marginal elemental load time; and the change in number of actual stops caused by a marginal change in system volume is the marginal coverage-related load time.

(footnote continued from previous page)
is variable with stops-coverage while coverage-related load on multiple delivery stops (MDR and B&M) is variable with deliveries-coverage. As this attachment will show, the Commission-approved treatment for multiple delivery stops is incorrect.

The specific relationships among volume, number of actual stops, average stop load time, and system load time are easier to identify when they are described mathematically. First, total system load time can be described in functional form as:

$$L = g(V/S) * S,$$

where: (L) is total system load time,
(g) is average load time per actual stop,
(V) is total system volume, and
(S) is the number of actual stops.

The function g(V/S) reflects that average load time per stop is dependent on average volume per actual stop, V/S. The number of actual stops also depends on volume and the number of possible stops in the system. This can be indicated by the actual stops function S(V,PS), where PS is possible stops. System-wide load time variability can then be shown as fully dependent on system volume and possible stops:

$$L(V,PS) = g[V/S(V,PS)] * S(V,PS).$$

The correct system-level variability can now be derived using this functional form. First, the marginal system load time change with respect to system volume is:

$$\begin{aligned} \partial L/\partial V &= [g' * (S - V * S_V)/S^2] * S + g * S_V \\ &= g' * (S - V * S_V)/S + g * S_V \\ &= g' * [1 - (V * S_V/S)] + g * S_V. \end{aligned}$$

The value (g′) is the marginal change in average load time per stop with respect to average volume per stop, or $g' = dg/dv$, where v is average stop volume or V/S. The value (S_V) is the marginal change in stops with respect to volume ($\partial S/\partial V$). The term ($V * S_V/S$), inside the brackets, is the stops-coverage volume variability.

Letting $E_S = V * S_V/S$ and substituting in the last expression for the marginal system load time change establishes that:

$$\begin{aligned} \partial L/\partial V &= g' * (1 - E_S) + g * (S/V) * E_S \\ &= g' * (1 - E_S) + (g/v) * E_S. \end{aligned}$$

This shows that system-level marginal load time is a weighted average of (1) the marginal change in stop load time (g′), and (2) the average load time per piece (g/v). The latter is weighted by the stops-coverage variability (E_S) and the former by one minus this value. If the probability of a marginal piece going to an existing stop is 100% ($1-E_S = 1$ and $E_S = 0$), then the marginal system load time is g′. In this case, the marginal change in system-wide load time is fully captured by the marginal change in average load time per stop (g′). On the other hand, if the probability of the marginal piece going to an existing stop is zero ($1- E_S = 0$ and $E_S = 1$), then the marginal system load time is g/v. In this last instance, the marginal change in system-wide load time is explained by the average load time per piece for the entire system.[3] This average stop time, g/v, reflects the average of the volume-variable plus fixed load time over all stops in the system. Thus, if there is a probability that the marginal piece will go to a new stop (if E_S is positive), then system-wide marginal load time will include some contribution from (g/v), including both the fixed and variable stop time components.

The system-level load time variability calculation follows directly. First, the elemental load variability, measuring variations in stop load time as average stop volume changes, is calculated from $E_e = g' * v/g = g'/(g/v)$. Then substituting in the weighted average expression for system-level marginal load time yields:

$$\partial L/\partial V = (g/v) * (E_e * (1 - E_S) + E_S).$$

[3] Scale economies in stop load time require that marginal stop load time, g', be less than the average stop load time, g/v. Stop-level scale economies also imply system-level scale economies when $E_S < 1$ for then $(\partial L/\partial V) < g/v$. It is also easy to see that, as stops-coverage variability increases, the system marginal load time also increases because the weight (E_S) applied to (g/v) is greater and that applied to (g') is less. Stated differently, when spreading the same system volume over a greater number of stops, scale economies are lost and system marginal load cost ($\partial L/\partial V$) increases.

Since g/v = (g * S)/(v * S) = L/V, substitution and multiplication by V/L gives:

$$(\partial L/\partial V) * (V/L) = E_e * (1 - E_s) + E_s$$
$$= E_e + E_s * (1 - E_e).$$

This shows that system level load time variability, $(\partial L/\partial V)*(V/L)$, is precisely equal to the sum of (1) elemental load variability, E_e, derived from the LTV load time model, and (2) the product of one minus this variability and the stops-coverage variability E_s, derived from the CCS coverage model. This is the correct approach to load time variability measurement and is the approach approved by the Commission for SDR stops. When applied to the correct measure of system-load time cost (LT), it produces the correct estimate of load time volume-variable cost:

$E_e * LT$ = Elemental Load Time

$(1 - E_e) * LT$ = Coverage-Related Load Time

$E_s * (1 - E_e) * LT$ = Volume-Variable Coverage-Related Load Time.

B. Variability of System-Wide Load Time for Multiple Delivery Stops

System load time and variability measurement for multiple delivery stops is based on the same load time measurement concepts that apply to SDR stops. However, for multiple delivery stops, there may be both stop-specific and delivery-specific activities. For example, at a multiple delivery stop, the carrier may have to open and close a combination multiple delivery receptacle and may have to sort mail to delivery addresses. Thus for multiple delivery stops, it is appropriate to measure total system load time as the sum of all stop-specific plus delivery-specific load time. Both components are calculated in the same way -- as the product of the average load time (per stop or delivery) and the corresponding number of units (stops or deliveries).

Mathematically, total system load time for multiple delivery stops is described by:

$$L = g(V/S) * S + h(V/D) * D$$
$$= g(V/S) * S + h(V/D) * D_S * S$$
$$= [g(V/S) + h(V/D) * D_S] * S,$$

where (D) is the number of system-level actual deliveries, (D_S) is the average number of actual deliveries per stop, and (h) is the average delivery load time shown as a function of average volume per delivery (V/D). From $V/D= (v * S) /(D_S * S) = v / D_S$ and $(V / S) = v$, the last expression becomes:

$$L = [g(v) + h(v / D_S) * D_S] * S.$$

In this last expression, total system load time is dependent on stop-level volume (v), actual deliveries (D_S) and the number of actual stops (S). The term in brackets indicates average load time per stop. This consists of two specific portions: a stop-specific portion, g(v), which cannot be traced to actual delivery points; and a delivery-specific portion, $h(v / D_S) * D_S$, which depends on the average delivery time (h) and the average number of actual deliveries per stop (D_S).

However, D_S also varies with respect to stop volume. Just as total system level deliveries change with system level volume, actual deliveries at the stop level change with stop-level volume. Load time changes are then fully explained by stop-level volumes with possible deliveries (d) added as a control variable. This is shown by writing D_S as a function of average volume per stop (v) and average possible deliveries per stop (d). System load time is then indicated by:

$$L = [g(v) + h[v / D_S(v,d)] * D_S (v,d)] * S$$
$$= g_m (v, d) * S.$$
$$= g_m (V / S, d) * S.$$

Load time per stop on multiple delivery stops, g_m, is shown to be a function of volume and possible deliveries per stop. As with single delivery stops, this shows that total system load time on multiple delivery stops is explained by system volume (V) and actual stops (S). The load time variability analysis for multiple delivery stops therefore proceeds in exactly the same way as indicated for single delivery stops. Both the elemental and coverage-related variability analysis are conducted at the stop level for multiple delivery stops for consistency with the LTV stop load time models. And, the stop-level elemental variability reflects the entire volume effect on the deliveries load time.

ATTACHMENT C

THE DELIVERIES EFFECT ON MULTIPLE DELIVERY STOPS

This attachment presents a critique of witness Baron's "deliveries" effect analysis. He describes the "deliveries effect" on multiple delivery stops as the "effect on load time of an increase in actual deliveries that volume growth will cause" (p. 17, USPS-T-17). He interprets the possible deliveries variable in the LTV model for MDR and B&M stop types as a proxy for stop-level actual deliveries; and, therefore, he interprets the coefficient value for this variable as transmitting the "deliveries effect." Based on that interpretation, he incorrectly updates the LTV model to (1) estimate elemental shape volume variabilities and (2) derive "deliveries" variabilities. He also incorrectly sums the elemental shape volume variabilities with the "deliveries" variabilities to develop an overall elemental load for multiple delivery stops. As demonstrated in Attachment B, the deliveries effect that witness Baron tries to capture is already subsumed in the elemental shape volume variabilities.

Mis-Use of the MDR and B&M Models

The MDR and B&M models are developed with a possible deliveries variable (PD). In order to derive his "deliveries" effect, Witness Baron calculates elemental variabilities from MDR and B&M models incorrectly updated with base year CCS actual deliveries per stop values rather than the correct possible deliveries per stop values. This procedure produces wrong estimates of marginal and stop load times which are then used by witness Baron to derive elemental load variabilities. In other words, witness Baron uses the actual deliveries (AD) value rather than the correct possible deliveries (PD) value with the model's PD coefficients. (ADVO/USPS-T17-1).

As part of the Load Time Variability Analysis design, possible deliveries data were collected and used in the LTV models as a control variable in order to develop unbiased estimates of stop load time and elemental variability. The number of possible deliveries has both a fixed and marginal effect on stop load time and, for this reason, was collected as part of the LTV data. As possible deliveries on a stop increase, there is a greater likelihood that existing mail volume produces a greater number of actual deliveries. There is also a "hunt and reach" casing effect to which the carrier may be subject, which likely increases as the number of possible deliveries at the stop increases. Both of these effects can increase the marginal (and total) time for loading mail. There may also be a fixed component of time (with respect to volume) that likely increases as possible deliveries become greater.

All these separate influences from possible deliveries on stop-level marginal and total load times require use of possible deliveries data for correct estimation of load time models and related volume variabilities. The traditional approach approved by the Commission includes the use of load time models estimated and updated with possible deliveries data. However, the stop-level marginal time, total load time and related variabilities must also be developed consistent with this correct model estimation procedure. The substitution of actual deliveries for possible deliveries in the models reduces the total modeled load time. As a result, it generates overstated MDR and B&M elemental variabilities.[1] The following table shows the overstatement of the elemental load variabilities for the multiple delivery stops:

	Mis-Estimated with Actual Deliveries	**Correctly Estimated with Possible Deliveries**
SDR	.61017	.61017
MDR.	.71026	.65129
B&M	.52665	.52107

USPS-T-17 Tables 5, 6, 7, 9, 10, 11.

1 Variability is simply marginal cost divided by average cost. If average cost decreases, the variability ratio increases. Witness Baron confirms this result (ADVO/USPS-T17-11). The above description is somewhat simplified since use of actual deliveries instead of possible deliveries also affects marginal time (through the cross-product variables).

Possible deliveries data are used in the development of LTV models as part of the correct process for isolating the load time effects following from stop-level volume variations. Variability estimation should be conducted consistent with the intended model development. Possible deliveries is required as a control variable for correctly estimating stop-level marginal and total load times. These lead to the correct variability values for volume variable cost estimation.

Double-Count of The Deliveries Effect

Witness Baron calculates his "actual deliveries variability" with respect to load time using the PD coefficient with the AD variable in the LTV models. Using the chain rule, he then multiplies this variability by the system-wide delivery coverage variability derived from CCS. (ADVO/USPS-T17-7). This resulting variability is intended to explain the effect of volume on load time transmitted through variations in actual deliveries. He then multiplies this "deliveries" variability by STS-based load costs (adjusted for fixed stop time) to produce a "volume-variable deliveries" cost. This cost is added to a separately calculated elemental load cost which witness Baron describes as measuring the effect of volume only on already covered deliveries.[2]

Witness Baron's addition of an "actual deliveries variability" is unnecessary and double counts the deliveries effect already included in the stop-level elemental variability. Greater stop-level volume affects load time both directly and indirectly because some of that volume increase is added to existing deliveries while the rest is added to new deliveries. Both effects, at the margin, are described mathematically in Attachment B.

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2 Witness Baron has redefined elemental load. Traditionally and correctly, elemental load has been accepted as the volume variable cost associated with the total effect of stop volume on stop load time.

A simplified LTV model can be used to demonstrate that the deliveries effect is a part of the overall volume effect on load time.[3] To see this, assume C_S is load time per stop and is explained by:

$C_S = F + (C_D * D)$, where:

F is a fixed stop time (including all receptacle, container, and possible deliveries effects),

v is volume on the stop (V/S),

D is number of actual deliveries, explained by $D = bv - cv^2$, and

C_D is time per actual delivery, or $C_D = f + p(v/D)$, where f is fixed time per delivery and p is per piece handling time.

With the appropriate substitutions, stop load time can be shown as:

$$C_S = F + [f + (p * (v/D)] * (bv - cv^2), \text{ or}$$

$$= F + [(f * b) + p)] * v - (f * c) * v^2$$

$$= F + p*v + (f * b)*v - (f * c) * v^2$$

The deliveries effect on load time is transmitted through the last two terms, $(f * b) * v - (f * c) * v^2$. Thus, variations in load time from this source are fully explained by variations in volume. Furthermore, the expression [(f * b) + p] is the $ß_k$ coefficient associated with the V_k variable in witness Baron's regression model [equation (3)], while the term (f * c) is the $ß_{kk}$ coefficient associated with the V_k^2 variable in the same model. As witness Baron agrees,[4] these coefficients produce the LTV volume variabilities used to develop elemental load time. And, while witness Baron does not agree, it is true that they also include the volume-variability associated with the

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3 For simplicity, this example assumes only one type of volume and no cross-products or other variables.

4 He shows this explicitly in his equation (2). See also ADVO/USPS-T17-6.

volume-related deliveries effect on stop load time because of the full explanation of the deliveries effect by the volume level.[5]

In summary, witness Baron's attempt to (1) estimate elemental load variabilities using actual deliveries rather than possible deliveries, and (2) add a "deliveries effect" variability to the elemental variability is incorrect. This procedure artificially inflates elemental load time variabilities for multiple delivery stops and double-counts the "deliveries" effect already included within the elemental variabilities.

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5 Accordingly, ECs (the stop-level elemental variability) is:

$$[(f * b + p) * v - (2 * f * c) * v^2)] / Cs$$

and is applied to LT to obtain elemental load time. Witness Baron explicitly denies that $ß_k$ and $ß_{kk}$ include the deliveries effect (ADVO/USPS-T17-5). He claims the coefficients measure only the stop load time effect of volume going to already covered deliveries. But, if that were the case, then ECs would only be (p * v)/Cs, and elemental load time would only be [(p * v)/Cs] * LT, or the sum of piece handling time, p*v, across all stops. Another way to view the deliveries effect is through changes in the fixed time per delivery (f), if there is any. Clearly, any changes in this time will affect the elemental load variability calculation as shown above.

ATTACHMENT D

AUTOBIOGRAPHICAL SKETCH

My name is Antoinette Crowder and I am a senior consultant with TRANSCOMM, Inc., an engineering and economic consulting firm located in Falls Church, Virginia. I have been associated with TRANSCOMM for twenty-five years and, during that time, have been involved in a variety of projects dealing with costing, pricing, market and demand studies, economic and financial analyses, and research on numerous regulatory and policy issues. These activities have concerned the electric power, gas, communications, and postal/publishing industries. I have prepared or assisted in preparing numerous filings at various federal and state regulatory agencies on behalf of numerous clients. In addition, I am involved in the firm's overseas consulting activities, providing financial, economic and regulatory assistance to multi-national organizations, international firms, and national governments.

I have been involved in analyses of postal ratemaking and policy issues since the beginning of the R77-1 rate case. My work has involved revenue requirement, cost attribution and distribution, subclass rate structure and discounts, institutional cost allocations, service-quality measurement, demand and market assessment, and mail classification issues. I am part of the TRANSCOMM team that provides economic/financial advice on postal matters and monitors costs, financial statements, volumes, service levels, and other aspects of Postal Service operations on behalf of several clients.

I have testified before the Postal Rate Commission in six proceedings and have contributed to development of other testimony presented to the Commission. In Docket R84-1, I contributed to peak-load and second-class intra-SCF discount testimony. In Docket R87-1, I contributed to carrier-out-of-office and third-class/fourth-class Bound Printed Matter drop-ship discount testimony, and I also prepared and presented rebuttal testimony on third-class presort discounts. In Dockets C89-

3/MC89-1, I helped prepare and presented direct testimony on the proposed local saturation subclass. In Docket R90-1, I assisted in preparation of carrier-out-of-office cost and institutional cost coverage testimony and prepared and presented rebuttal testimony on third-class rates. In the R90-1 Remand, on behalf of a third-class mailer's group, I presented testimony concerning the attribution of city carrier coverage-related costs. I also presented two pieces of rebuttal testimony in Docket R94-1 and a rebuttal testimony in MC95-1.

Over the course of my 20-year involvement in postal ratemaking matters, I have had numerous opportunities to observe postal operations and have analyzed the cost aspects of those operations. I have also become familiar with economic costing and pricing concepts, both generally and as applied to postal ratemaking.

My education includes a B.S. in Biology from the University of Virginia, an M.S. in Biology from George Mason University, and additional course work in economics, mathematics and statistics.

CERTIFICATE OF SERVICE

I hereby certify that I have on this date served the foregoing document upon all participants of record in this proceeding in accordance with section 12 of the Rules of Practice.

Thomas W. McLaughlin

February 2, 1998